

Preschool Quality Effects on Learning Behavior and Later Achievement in Germany: Moderation by Socioeconomic Status

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This study investigates whether children's preschool experiences are associated with later achievement via enhanced learning behaviors using data from a German longitudinal study following children ($N = 554$) from age 3 in preschool to age 8 in second grade. There were two main findings. First, results suggest that more positive learning behaviors at school entry mediate effects of teacher-child interactions in preschool on second-grade achievement. Second, these effects varied by parental socioeconomic status (SES) indicating that low-SES children benefited the most. The findings highlight the role of preschool classroom environments in shaping the school readiness of children with socioeconomic risk factors.

Children's experiences in early childhood education (ECE) are foundational to later school success. There is ample evidence that the features of early teacher-child interactions contribute to the development of children's school readiness skills, in particular their early academic skills (Mashburn et al., 2008; NICHD Early Child Care Research Network, 2016; Sylva et al., 2006) and, to some degree, to their self-regulatory and executive functioning skills (Fuhs, Farran, & Nesbitt, 2013; Hamre, Hatfield, Pianta, & Jamil, 2014; Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009; Weiland, Ulvestad, Sachs, & Yoshikawa, 2013). These skills have been shown to be among the strongest predictors of later academic achievement in large-scale longitudinal studies (Duncan et al., 2007; Morgan, Farkas, Hillemeier, Pun, & Maczuga, 2019; Pagani, Fitzpatrick, Archambault, & Janosz, 2010; Watts, Duncan, Siegler, & Davis-Kean, 2014).

At the same time, learning-related behaviors are being recognized as important contributors to achievement trajectories in the elementary years over and above children's school-entry academic and self-regulatory skills (Alexander, Entwisle, & Dauber, 1993; Duncan & Magnuson, 2011; Fantuzzo, Perry, & McDermott, 2004; Li-Grining, Votruba-Drzal, Maldonado-Carreño, & Haas, 2010; McClelland, Acock, & Morrison, 2006; McDermott, Rikoon, & Fantuzzo, 2014; Sasser, Bierman, &

Heinrichs, 2015). Moreover, there is some evidence suggesting that learning-related behaviors mediate the effects of early self-regulatory and executive functioning skills on later achievement (Nesbitt, Farran, & Fuhs, 2015; Sasser et al., 2015; Sung & Wickrama, 2018).

Despite their importance for academic achievement, however, only few researchers have addressed whether children's learning-related behaviors at the beginning of formal schooling are affected by their early preschool experiences embodied in the qualities of teacher-child interactions (Domínguez, Vitiello, Maier, & Greenfield, 2010; Rimm-Kaufman et al., 2009). The available evidence suggests positive influences of high-quality preschool programs on children's learning-related behaviors. This, in turn, raises the question as to whether such effects provide a possible mechanism that explains some of the relation between preschool quality and children's later academic achievement.

A crucial issue in this regard is whether potential preschool quality effects on learning-related behaviors are more important to children from disadvantaged socioeconomic backgrounds. Although a large body of research has documented the developmental importance of early teacher-child interactions for school readiness skills, it remains a topic of intense debate if the quality of early education is

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related to developmental outcomes differently for children with socioeconomic risk factors (e.g., Dearing, McCartney, & Taylor, 2009; Keys et al., 2013; Schmerse et al., 2018; Votruba-Drzal, Coley, & Chase-Lansdale, 2004). Thus far, research has examined differential effects of preschool quality for various outcomes including academic skills, social skills, and problem behaviors. However, it has not yet been established whether effects of early teacher–child interactions on children’s learning-related behaviors vary by parental socioeconomic status (SES).

This study seeks to address these issues using a longitudinal dataset following children from age 3 in preschool to age 8 in second grade. Specifically, the aim of this study is to determine if the relation between preschool quality (teacher–child interactions) and children’s learning-related behaviors at school entry provides a mediational pathway for the effect of early preschool experience on later achievement. In addition, the study addresses potential moderating effects of these proposed processes for children with different SES family backgrounds. Previous research has indicated that children’s learning-related proficiency covaries with an at-risk socioeconomic background (McClelland, Morrison, & Holmes, 2000; Morgan, Farkas, Hillemeier, & Maczuga, 2009; Sung & Wickrama, 2018). Therefore, it was hypothesized that preschool quality exerts a compensatory role. Low-SES children were predicted to profit most from positive effects of teacher–child interactions on their learning behavior and, indirectly, on their later achievement.

Learning-Related Behavior and Academic Achievement

Learning-related behavior, or simply learning behavior, is considered an umbrella term comprising a set of skills and dispositions that indicate ways in which children approach and stay engaged in learning situations (Domínguez et al., 2010; Fantuzzo et al., 2004). These skills facilitate learning by allowing children primarily to persevere with difficult tasks and to work independently and are typically assessed using teacher rating scales of daily classroom behavior (Fantuzzo et al., 2004; McDermott, Leigh, & Perry, 2002; Razza, Martin, & Brooks-Gunn, 2015). Measures of learning-related behavior, sometimes referred to as *approaches to learning*, typically include assessments of attentiveness, persistence, frustration tolerance, and learning independence, but may also include curiosity as well as the ability to self-organize (Domínguez et al., 2010; Duncan & Magnuson, 2011). Learning-

related behaviors are distinct from (and even outweigh) social functioning in the classroom in predicting gains in academic achievement (Alexander et al., 1993; Duncan et al., 2007). Children with more positive learning-related behavior at 5–6 years show stronger growth trajectories in their reading and mathematics achievement over the course of the elementary years (Alexander et al., 1993; Li-Grining et al., 2010; McClelland et al., 2006; Stipek, Newton, & Chudgar, 2010). At the same time, children with low academic skills at kindergarten entry benefit the most from enhanced learning behaviors in their later achievement (Razza et al., 2015).

More recent evidence highlights the mediating role of learning-related behavior on academic trajectories during the preschool and early elementary years (Nesbitt et al., 2015; Sasser et al., 2015; Sung & Wickrama, 2018). These studies report indirect effects of executive function (EF) skills on achievement gains via learning-related behaviors. These findings are consistent with the idea that learning behaviors represent the behavioral consequences of self-regulatory and EF skills which are directly relevant to children’s engagement in academic routines and classroom adaptation (Duncan & Magnuson, 2011; McClelland & Cameron, 2012). Likewise, some have argued that behaviors related to learning engagement at the transition into formal schooling are ontogenetically rooted in early childhood self-regulatory abilities (Blair & Raver, 2015; Eisenberg, Duckworth, Spinrad, & Valiente, 2014). Some evidence for this hypothesis comes from findings of Fantuzzo et al. (2004) who found moderate-sized concurrent associations between 4.5-olds’ learning-related behaviors and their teacher-rated abilities of self-regulation. Similarly, for the same age group, Ponitz et al. (2008) reported associations between children’s adaptive classroom behaviors and a facet of their EF skills (inhibitory control), although relations were relatively small-sized. Finally, Nelson et al. (2017) observed that children who enter elementary school with poorer self-regulatory and attention skills spend more time in classroom behaviors such as looking at the teacher, hand-raising, and locating materials at the expense of focused engagement in academic tasks. Taken together these findings draw a coherent picture of concurrent and short-term associations between self-regulatory abilities and learning-related behaviors during the late preschool and early elementary years.

Whether learning-related behaviors are conceptually distinct from self-regulation is the topic of considerable debate (McClelland & Cameron, 2012;

McDermott et al., 2014; Nelson et al., 2017). Self-regulation is conceptualized as a broader system of functions that organize top-down control of goal-directed behavior (Blair & Raver, 2015; Nelson et al., 2017). There is no doubt that children's adjustment to classroom demands implicate skills to manage attention, emotions, and to inhibit behavior and that these skills facilitate engagement in learning activities. Nevertheless, despite substantial conceptual overlap, researchers have also argued to distinguish between aspects of *emotional self-regulation*, *cognitive self-regulation*, and *learning-related behavior* (Duncan & Magnuson, 2011; Stipek et al., 2010) as they represent interconnected but not fully congruent constructs. One argument that has been brought forward is that learning behaviors reflect adaptive responses to specific classroom demands and are considered more proximal to classroom learning (McDermott et al., 2014; Nesbitt et al., 2015; Sasser et al., 2015). Given the way learning behaviors are assessed, these measures may also partly tap motivational components, for example, to comply with group norms or to succeed in challenging situations (Eisenberg et al., 2014), as compared to self-regulation or EF measures. In this study, it is assumed that children's early self-regulatory skills contribute to, but are not identical to, their learning-related behaviors.

One of the key challenges in assessing learning-related behaviors as children transition from preschool into formal schooling is identifying those dimensions that are ultimately relevant to future academic success (or failure) and that show effective continuity across educational stages. For children in preschool, kindergarten, and first grade, large-scale studies have identified *competence motivation* and *persistence* as two conceptually similar and temporally consistent dimensions of learning-related behaviors that are predictive of future academic success (McDermott et al., 2014). When comparing these and other dimensions of learning-related behavior, Vitiello, Greenfield, Munis, and George (2011) found that persistence but not other dimensions played a significant role in mediating the relation between EFs and academic school readiness in a low-income sample of preschoolers. This suggests that persistence (e.g., focusing on an activity, not seeking distraction when engaged, not becoming aggressive when frustrated, McDermott et al., 2014) may potentially be involved in a mediational pathway between school entry skills and later achievement which might be particularly relevant to students from an at-risk socioeconomic background. Moreover, children's early ability to persist

in learning situations in the face of challenge has also been found to predict achievement at age 21 (controlling for achievement levels at age 7) as well as the odds of college completion at age 25 (McClelland, Acock, Piccinin, Rhea, & Stallings, 2013) again suggesting that enduring and goal-directed engagement is a critical dimension of learning-related behavior relevant to long-term academic success. Taken together, teachers' assessments of children's ability to persist in classroom activities is a suitable measure to capture highly relevant aspects of learning behavior during transition to formal schooling (Domínguez et al., 2010; McDermott et al., 2014). However, despite its importance for adapting positively to demanding academic tasks of formal schooling, only few studies have addressed the role of the preschool classroom environment in shaping children's ability to persevere in challenging classroom activities as an important component of learning behavior.

Preschool Quality Effects and Learning-Related Behavior

High-quality programs of early childhood education (ECE) have positive long-term effects on children's developmental outcomes (Vandell et al., 2010). The key factor in children's early preschool experiences are high-quality teacher-child interactions that determine developmental consequences in children's academic, language, and social development (Mashburn et al., 2008). Based on observations from 671 pre-K classrooms, Mashburn et al. (2008) found that the quality of teachers' emotional and instructional support assessed with the CLASS instrument (Pianta, LaParo, & Hamre, 2008) predicted a broad range of children's school readiness skills. Furthermore, these authors reported that using different measurers of classroom quality produced incongruent findings. While the interaction-focused measure CLASS revealed associations across a range of academic and social school readiness outcomes, the total score of the quality measure Early Childhood Environment Rating Scale-Revised Edition (ECERS-R; Harms, Clifford, & Cryer, 1998) was only linked to children's development of expressive language skills. It has therefore been suggested that the ECERS-R total score may be less suited for school readiness studies because of its emphasis on aspects of the environment (e.g., materials, health practices, and safety) rather than interactional quality. Acknowledging these concerns, some studies have indicated that the ECERS-R Interaction score, which comprises items that predominantly capture the quality of

teacher–child interactions, is a more sensitive measure to the effects of classroom process quality on child outcomes than the overall ECERS–R score (e.g., Burchinal, Vandergrift, Pianta, & Mashburn, 2010; Howes et al., 2008). Meta-analytic work supports the assumption that the ECERS–R Interaction Factor, but not the ECERS–R total score, is predictive of gains in children’s verbal and socioemotional outcomes (Burchinal, Zaslow, & Tarullo, 2016).

In recent years, there has been a growing interest in the differential nature of these effects concerning quality “thresholds” (Burchinal et al., 2016), but also their domain-specificity regarding both the interaction as well as the outcome dimensions (Hamre et al., 2014). That is, researchers have begun to look at a broader range of school readiness outcomes beyond preacademic skills and to examine associations between early teacher–child interactions and, for example, children’s EFs (Fuhs et al., 2013; Hamre et al., 2014; Hatfield, Burchinal, Pianta, & Sideris, 2016; Levya et al., 2015; Weiland et al., 2013) and classroom behaviors (Domínguez et al., 2010; Rimm-Kaufman et al., 2009). With regard to children’s EFs, observations of preschool classroom quality based on the CLASS instrument have linked the domains Classroom Organization and Emotional Support to children’s working memory capacity and levels of inhibitory control (Hamre et al., 2014; Levya et al., 2015). Moreover, there is evidence for quality thresholds in the relation between these dimensions and children’s EF indicating that relations between inhibitory control and both Classroom Organization and Emotional Support are higher when teacher–child interactions are more effective (Hatfield et al., 2016).

More to the point of learning-related behavior, Rimm-Kaufman et al. (2009) found that 5-year-old children who were enrolled in kindergarten classrooms with higher quality classroom management showed more positive work habits, spent less time off task, and were rated as more engaged in learning (controlling for prior levels of self-regulation). In a similar vein, Domínguez et al. (2010) examined growth trajectories of 4-year-olds’ learning-related behavior during the prekindergarten year in relation to classroom quality. These authors, too, found high-quality classroom management, but not other dimensions, to be a significant predictor of children’s growth in learning behavior. The evidence from these studies suggests that the effect of teacher–child interactions on children’s learning behavior provides a possible underlying mechanism for the relation between preschool quality and children’s later academic achievement.

Differential Effects of Preschool Quality

It is often assumed that associations between preschool classroom quality and school readiness outcomes are moderated by children’s entry-level skills and socioeconomic family characteristics. Especially children at risk are hypothesized to benefit from attending high-quality preschool environments. However, evidence that effects of higher preschool quality vary by academic or socioeconomic risk factors is mixed in the literature. While some studies (e.g., Dearing et al., 2009; Votruba-Drzal et al., 2004) demonstrate compensatory effects, others have found that children from more advantaged home leaning environments profited more from high preschool quality (e.g., Anders et al., 2012; Schmerse et al., 2018). Recent meta-analytic research on longitudinal correlational data revealed limited evidence to support the hypothesis that effects of preschool quality are moderated by children’s entry-level skills or socioeconomic family characteristics (Keys et al., 2013). On the other hand, meta-analytic investigations on quasi-experimental evaluations of programs that focus particularly on children from low-income families provide largely consistent evidence of positive program impacts although they appear not to be long-term (Duncan & Magnuson, 2013). In spite of these results, interpreting findings on differential effects of preschool quality is complicated by the fact of socioeconomic gaps in preschool participation. Children from socioeconomically disadvantaged families are enrolled less often in ECE programs (Bassok, Finch, Lee, Reardon, & Waldfogel, 2016), enter programs at a later age, and are less likely to receive access to high-quality teacher–child interactions (Bassok & Galdo, 2016). Despite numerous ECE studies, our current understanding of which skills are suited best to generate ECE effectiveness for socioeconomically disadvantaged children is incomplete (Duncan & Magnuson, 2013). The vast majority of existing studies that have investigated moderator effects of SES on associations between preschool quality and school readiness outcomes have focused on preacademic skills related to literacy and numeracy. Nevertheless, long-term benefits from attending ECE may also result from impacts on a broader set of skills including behavioral self-regulation and learning behaviors. With respect to learning behaviors, however, evidence on SES-related dependencies of preschool quality effects is sparse. Only one study has directly tested whether classroom quality effects on learning-related behavior prior to elementary school are moderated by

children's entry-level skills. In this study, Rimm-Kaufman et al. (2009) found no significant interaction between children's kindergarten entry-level self-regulatory skills and quality measures of teacher-child interactions. Interestingly, however, no study has investigated the moderating role of socioeconomic risk status on the effects of classroom quality on learning behaviors. This absence of empirical work is surprising given the evidence that children with lower learning-related skills are more likely to come from families with low educational attainment and low occupational status (McClelland et al., 2000; Morgan et al., 2009; Rimm-Kaufman et al., 2009; Sung & Wickrama, 2018). Developmental models of school readiness hold that low proficiency in skills that allow children to adapt to classroom demands is a primary mechanism through which economic adversity affects school readiness (Blair & Raver, 2015). Thus, it is possible that children from disadvantaged backgrounds are more likely to benefit from higher classroom quality in enhancing their ability to persist in learning situations and, indirectly, in later achievement.

The Present Study

Research on the role of early classroom environments in shaping children's learning-related behaviors suggests that children's ability to persist in learning activities may provide an underlying mechanism by which preschool quality relates to later academic achievement. Thus far, however, this assumption has not been tested. This study therefore addresses this paucity in empirical work and adds to previous research by examining whether preschool quality effects on children's ability to persist in classroom activities vary by socioeconomic background. The goal of this study was to determine (a) whether children's persistence in academic tasks at the transition into formal schooling is associated with the quality of their previous preschool experiences, (b) whether persistence mediates the link between preschool quality and academic achievement in second grade, and (c) whether these proposed associations are more favorable to children from socioeconomically disadvantaged backgrounds. The findings of the present investigation may substantiate the central role of learning behaviors among the different ways in which preschool prepares children for formal schooling beyond fostering their preacademic skills. The study highlights a process that might be particularly advantageous to children from at-risk socioeconomic backgrounds. Therefore, the results of this study

contribute to the literature on differential effects of preschool quality by drawing attention to a school readiness outcome that has received less attention previously.

Method

Sample

The data of the present investigation came from the German longitudinal study BiKS-3-10 (Weinert, Roßbach, Faust, Blossfeld, & Artelt, 2013). The initial sample comprised 554 children (48.2% female) from 97 preschools who were enrolled in start of elementary school in fall 2008. Within each preschool, one classroom was selected at random. Among parents, 22% reported speaking a native language other than German. Data collection started in fall 2005. Children's mean age was 3.7 years ($SD = 5.0$ months) at first assessment and 8.2 years ($SD = 4.1$ months) at assessment in second grade. The average age of preschool entry was 2.4 years ($SD = 13.1$ months). Note that in the German ECE system children attend preschool ("Kindergarten"), which is not part of the school system, typically from age 2 to 6 years. Transition into formal schooling starts with entry into elementary school at the age of 6 to 7 years. In most German states, all students attend elementary school from Grade 1 to Grade 4 after which they transfer to one of four different types of secondary school (tracking).

While the vast majority of the initial sample enrolled in elementary school, there was also sample attrition after children transferred from preschool to elementary school. The original sample comprised 554 children. After transfer to elementary school 435 children from 87 schools and 142 classes remained in the sample. Of these 435 participants another 108 children could not be followed into Grade 2 because their schools did not agree to further participate in the study. As in any longitudinal study sample attrition can bias results. In order to examine possible biases due to attrition, dropout comparisons were performed including covariates, SES, preschool entry skills, and preschool quality measures of children who participated throughout with those who dropped out after preschool. Comparisons were conducted using *t*-tests for independent samples and found no significant differences with respect to SES, maternal education, age of preschool entry, preschool quality (ECERS-R), parent-child interaction quality, and children's preschool entry self-regulatory skills (see Table S1). Differences were found with respect to

preschool entry numerical skills ($t(527) = 2.20$, $p = .03$) with a small effect size (Cohen's $d = .17$).

Measures

Preschool Quality

Preschool process quality was assessed at age 4 using the German adaptation (Tietze, Schuster, Grenner, & Roßbach, 2007) of the ECERS-R (Harms et al., 1998). Instead of using the overall ECERS-R score, the current analyses relied on the ECERS-R Interaction score (range: 1–7, $M = 4.33$, $SD = 1.10$) provided in the BiKS scientific use files. Several studies have indicated that the ECERS-R Interaction score, which predominantly captures the quality of teacher–child interactions, is a more sensitive measure to the effects of classroom process quality on child outcomes than the overall ECERS-R score (e.g., Burchinal et al., 2010; Howes et al., 2008). The 10 items comprising the scale (e.g., encouraging children to communicate, encouraging children to develop reasoning skills, staff–child interactions, interaction among children, or discipline) describe the extent to which teachers are actively engaged with children and encourage learning (Cronbach's $\alpha = .83$). According to the classification of Harms et al. (1998), scores from 1 to 2.9 indicate poor quality, scores 3–4.9 medium to good quality, and scores > 5 good to excellent quality. Thus, scores for the present sample indicated medium to good quality.

Learning Behavior: Persistence

Items representing persistence in academic tasks in the BiKS study were adapted from the subscales *persistence* and *attitudes toward learning* of the FEES questionnaire (Rauer & Schuck, 2004) assessing children's academic motivation and social experiences in elementary school. A self-rating version has been widely used in large-scale assessments in nationally representative samples of elementary school students (Kocaj, Kuhl, Jansen, Anand Pant, & Stanat, 2018; Rjosk, Richter, Lüdtke, & Eccles, 2017). A teacher rating version of the scale has been used in a large-scale study with 1,644 elementary students and 147 teachers from Germany (Schneider, 2011) providing evidence for internal and convergent validity. Teacher ratings of the scale in first grade correlated substantially with students' report card grades in math and German in third and fourth grade (range $r = .66$ – $.72$) as well as with school recommendations for tracking level at the transition to secondary school ($r = .72$).

In this study, teachers rated children's persistence in first grade (age 7.1 years). Teachers regularly observe a wide range of children's classroom behavior (that are not observed by parents) and they can reliably differentiate among children on the basis of their classroom participation (Domínguez et al., 2010; Milfort & Greenfield, 2002). Teachers were asked to rate five items indicating how well a given characteristic described the child 6 months after school entry (scale ranging from 1 = *does not apply* to 4 = *does apply*): "makes an effort when assignments are difficult," "works largely independently," "gives up easily when something is difficult," (recoded) "works diligently in the classroom," and "needs a lot of support in doing her/his tasks" (recoded). In the present investigation, the persistence scale revealed good internal consistency ($\alpha = .84$). The scale score as used in the current analyses was computed as the mean of the items comprising the score ($M = 2.86$, $SD = 0.64$).

Achievement

Mathematical skills. Mathematics achievement in second grade was measured using the *arithmetic* subtest of the German version of the Kaufman Assessment Battery for Children (K-ABC; Melchers & Preuss, 2003). All sets of the K-ABC subtest *arithmetic* including, for example, number identification (larger than 100), addition, subtraction, multiplication, and division operations were administered to children in individual testing situations. Children could reach a maximum raw score of 37 ($M = 26.1$, $SD = 3.06$). Sum scores as provided in the scientific use files were used in the current analyses.

Reading. As a measure of reading achievement, the standardized Salzburg Reading Screening (SLS 1–4; Mayringer & Wimmer, 2003) was administered in second grade. Children were asked to read out loud a list of simple sentences and judge their content as either correct or incorrect (e.g., "Bananas are blue"). Sum scores of correct answers as provided by the BiKS scientific use files were included in the analyses. Psychometric validation of the SLS with a large-scale sample has provided evidence for good reliability ($r = .90$) and convergent validity with the subtest *text comprehension* ($r = .81$) of the standardized Salzburg Reading and Writing Test (SLRT; Landerl, Wimmer, & Moser, 1997).

Control Predictors

In order to control for prior individual differences in children's ability to persist in challenging academic tasks and in keeping with prior research,

a baseline measure for *self-regulation* was included in the analyses as a control predictor (Eisenberg et al., 2014; Rimm-Kaufman et al., 2009). Furthermore, preschool *mathematical skills* and *phonological working memory* capacity served as relevant baseline control predictors for later achievement outcome measures. In order to additionally control for biases arising from nonrandom parental selection of preschool contexts (Duncan & Raudenbush, 1999), measures of socioeconomic background and parenting characteristics (quality of parent-child interactions and parental reports of children's home learning environment) were included to help reduce possible selection biases. Note that all control predictors were assessed at age 3.7 years. All analyses additionally controlled for children's gender, home language, maternal education, and age of preschool entry.

Self-regulation. Self-regulation includes children's ability to manage emotions and to shift and focus their attention (Blair & Raver, 2015). In keeping with prior research (Rimm-Kaufman et al., 2009), self-regulation was included as a control predictor of children's ability to persist in learning situations. Preschool teachers' ratings of children's ability to manage emotions and to focus their attention were based on the German short-form adaptation of the California Child Q-Sort-Test (Block & Block, 1980; Göttert & Asendorpf, 1989). In previous research, the California Child Q-Sort self-regulation subscales (Shields & Cicchetti, 1997) have been shown to provide evidence for convergent validity with the persistence dimension of learning-related behavior (see Fantuzzo et al., 2004). In this study, teachers rated how well a given characteristic described the child on a 4-point scale (1 = *does not apply*, 4 = *does apply*), for example, "attentive and able to concentrate," "easily loses interest and switches from one activity to another" (recoded), "completes a game or task before starting something new," "easily irritated and or angered" (recoded), or "overreacts to minor frustrations" (recoded). The self-regulation scale showed good internal consistency ($\alpha = .83$).

Phonological working memory. Children's phonological working memory was assessed using the *nonword repetition* subtest of the standardized German language development test for 3- to 5-year-olds, *SETK 3-5* (Grimm, 2001). Nonword repetition has been shown to predict both vocabulary and reading skills during the early school years and to have higher and more consistent relations with these language skills than other measures of phonological memory (Gathercole, Willis, Baddeley, &

Emslie, 1994). Children were asked to repeat 13 nonwords in total. Sum scores of correct answers ($M = 5.54$, $SD = 3.28$) were used in the current analyses. The nonword repetition subtest has revealed good reliability ($\alpha = .77$) in prior research (Grimm, 2001).

Mathematical skills. Early mathematical skills were measured using the *arithmetic* subtest of the German version of the K-ABC (Melchers & Preuss, 2003). The scale assesses children's skills in counting, identifying numbers, knowledge of shapes, and understanding of early mathematical concepts. Children were presented with Sets 1-3 of the K-ABC using the regular termination criterion. In Sets 1 and 2, children had to count objects, identify numerals up to 10, and identify two-dimensional shapes. In Set 3, children had to solve various numerical problems such as comparing quantities of objects or understanding numbers as symbols (in the range of up to 10). The BiKS data distribution provides sum scores of correct answers ($M = 4.90$, $SD = 3.38$).

Home learning environment. Parents reported on the quality of children's home environment based on an adaptation of the Home Observation for the Measurement of the Environment (HOME; Caldwell & Bradley, 2003). A composite score for items addressing the frequency of activities related to learning and academic stimulation on a 4-point scale (1 = *seldom/never*; 4 = *frequently*) was calculated using parental reports ($M = 2.62$, $SD = 0.46$, range = 1.50-3.80). The scale comprised 10 items (e.g., "I encourage my child to recognize or read letters and words, e.g., his own name or the name of his favorite animal" or "I encourage my child to learn numbers.") and showed acceptable internal consistency (Cronbach's $\alpha = .73$).

Parent-child interaction. Parents participated in semi-standardized picture-book-reading situation with their children (Kuger, Pflieger, & Roßbach, 2005). During interviews in home visits, parents were presented with specifically developed picture-books and were asked to read with their children "as they would do normally." Interviewers were trained for reliable coding (> 80% agreement) and rated the quality of parent-child interactions based on items adapted from the HOME on a 7-point scale for eleven aspects of cognitive stimulation (e.g., addressing numbers, letters, spatial concepts, categorization, or analogy formation). The scale showed acceptable internal consistency (Cronbach's $\alpha = .73$). The mean across items comprising the scale were utilized in the analyses ($M = 3.23$, $SD = 0.33$).

Socioeconomic status. Parental SES was measured using the International Socio-Economic Index of occupational status (ISEI; Ganzeboom & Treiman, 1996) and was based on the highest value among parents if two values were present. The index captures the attributes of occupations that convert parents' education into income and can take a lowest value of 16 (nonskilled workers) and a highest value of 90 (judges). In the BiKS-3-10 sample, the mean value for highest ISEI was 55.0 ($SD = 15.2$). The standard deviation of the SES index in the present sample is comparable to the OECD average at the time of data collection (OECD, 2010). Thus, the sample is characterized by an average social heterogeneity.

Child-staff ratio. Child-staff ratio was assessed as a control measure for structural preschool quality. The child-staff ratio was calculated based on observations of children and adults present in a given classroom on several occasions throughout the day. Ratios indicate number of children per staff member, that is, lower ratios indicate fewer children per staff member ($M = 5.93$, $SD = 3.33$, range = 1–19).

Analytic Approach

Moderated Mediation

Path models testing for moderated mediation were specified following Preacher, Rucker, and Hayes (2007). The path model is presented in Figure 1. In this model, academic achievement in

second grade was predicted by preschool baseline controls (mathematical skills, self-regulation, and phonological working memory), SES, quality of the home learning environment, and quality of the preschool environment (child-staff ratio, teacher-child interaction) as well as persistence (mediator). The mediator variable was predicted by the baseline control measures, SES, learning environment quality measures, and covariates to test for indirect effects of preschool quality on achievement.

Moderated mediation occurs when the strength of an indirect effect depends on the level of another variable (moderator). There are multiple ways in which the magnitude of an indirect effect may be dependent upon a moderator. Here, the central question was whether the strength of the *a*-path (effect of preschool quality on persistence) was contingent on the level of the moderator SES. In addition, moderator effects of SES on the relation between preschool quality and the outcome variable (*c'*-path) were tested. To this end, interaction terms between preschool quality and parental SES were included as predictors for the mediator (*a*-path) and the outcome variable (*c'*-path). Variables included in interaction terms were grand-mean-centered. All analyses were performed in *Mplus*, Version 7.4 (Muthén & Muthén, 1998–2012). In a second step, conditional indirect effects were tested for different levels of the moderator variable SES ($-1 SD$, M , $+1 SD$). The presence and strengths of indirect effects were assessed in *Mplus* by using the MODEL INDIRECT command. To check the robustness of the results, analyses were also conducted

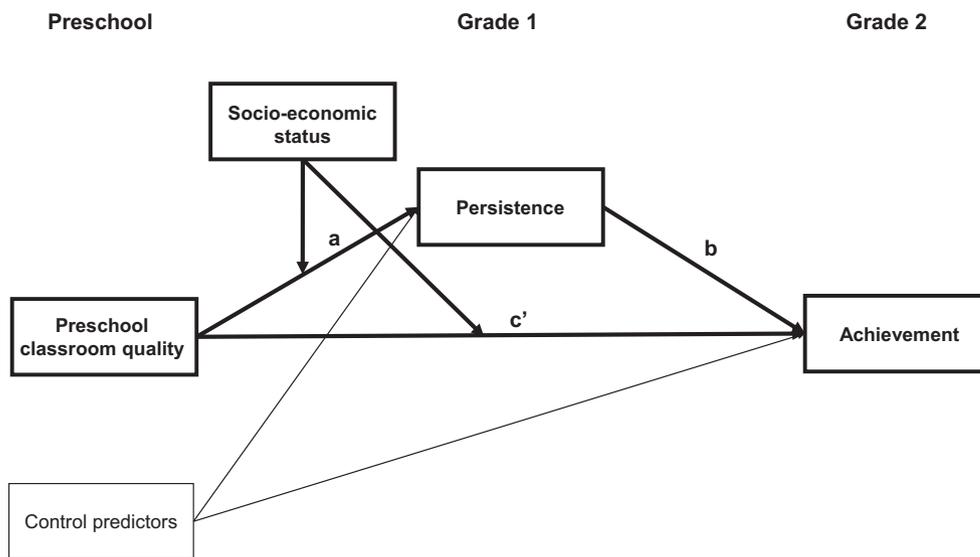


Figure 1. Path model testing moderated mediation. Control predictors include preschool self-regulation, mathematical skills, and phonological working memory, as well as parent-child interaction quality, home learning environment, and preschool child-staff ratio.

Table 1
Descriptive Statistics for Major Study Variables

	<i>n</i>	<i>M</i>	<i>SD</i>	α	Min	Max	Skew
Central variables							
ECERS-R Interaction Factor	550	4.31	1.09	.83	1.7	6.9	-0.08
Persistence	263	2.86	0.64	.84	1	4	-0.49
Mathematical skills (K-ABC)	327	26.11	3.06	n.a.	16	37	0.31
Reading achievement	326	27.63	10.22	.77	1	52	-0.06
Control variables							
Self-regulation	493	2.88	0.43	.83	1	4	-0.42
Phonological working memory	522	5.54	3.28	.77	0	13	-0.06
Mathematical skills (K-ABC)	529	4.90	3.38	n.a.	0	14	0.31
Socioeconomic status (ISEI)	439	55.00	15.22		20	90	0.14
Parent-child interaction	536	3.23	0.58	.73	1.7	6.0	0.29
Home learning environment	442	2.62	0.46	.73	1.5	3.8	-0.01
Child-staff ratio	550	5.93	3.33		1	19.0	1.18

Note. Minimum and maximum values refer to actual ranges in the sample. Child-staff ratio: number of children divided by the number of staff present. ECERS-R = Early Childhood Environment Rating Scale-Revised Edition (Interaction Factor); ISEI = International Socio-Economic Index; K-ABC = Kaufman Assessment Battery for Children; n. a. = not available from scientific use file.

using a bootstrapping procedure ($n = 5,000$) to estimate standard errors and to obtain confidence intervals as recommend by Preacher and Hayes (2008).

Hierarchical Data Structure

The original sample comprised 554 children from 97 preschools. The vast majority of those children transferred to elementary schools. In first grade, 435 children from 87 elementary schools and 142 classes remained in the sample. Thus, the study produced a cross-classified data structure. To account for the hierarchical structure of the data, cluster-robust standard errors in *Mplus* were specified by setting TYPE to COMPLEX using children's preschool classroom ID to correct the standard errors for the hierarchical dependency of the data (McNeish, Stapleton, & Silverman, 2017). The Intraclass Correlation Coefficients of preschool baseline measures and SES were .22 for early mathematical skills, .14 for SES, .11 for self-regulation, and .09 for phonological working memory indicating that a moderate to large proportion of the total variance in the predictor variables (preschool entry skills and SES) was located between preschool classrooms. Clustering at the level of preschool classrooms instead of elementary school classrooms was used because the preschool level represents the original level of sampling. Additionally, robustness checks using cluster-robust standard errors based on children's elementary schools' classroom ID were also performed (see Table S3).

Missing Data

Due to sample attrition over time, rates of missingness varied by time point of assessment. Variables at Time 1 had between 1% and 21% missing values, variables assessed at Time 2 had 52% missing data, and variables at Time 3 had 41% missing data (see Table 1). Dropout analyses revealed that children who provided follow-up data did not systematically differ from those who did not (see Table S1), thus supporting the assumption that sample attrition was unsystematic and that missing data patterns were missing at random (MAR) which means that the probability of missing data on a variable X depends on other measured variables, but not on the value of X itself. In the current analyses, missingness was addressed by applying full information maximum likelihood (FIML) estimation which is based on the MAR assumption. FIML is a state-of-the-art, computationally efficient procedure to handle missing data and generally recommended over simpler procedures such as listwise or pairwise deletion (Enders, 2010; Schafer & Graham, 2002). When implementing FIML in the current model, all variables and covariates which are potentially related to the probability of missing data were included, thereby increasing the plausibility of the MAR assumption (Enders, 2010). Older and simpler methods for handling missing data that rely on complete cases such as listwise deletion are an undesirable option because they assume that missing data are completely at random.

Table 2
Correlation Matrix of Major Study Variables

	1	2	3	4	5	6	7	8	9	10
1. Self-regulation (T1)										
2. Phonological working memory (T1)	.13*									
3. Mathematical skills (T1)	.24***	.52***								
4. Socioeconomic status (T1)	.15**	.19***	.17**							
5. Parent-child interaction (T1)	.05	.15**	.16**	.28***						
6. Home learning environment (T1)	-.04	.06	.16**	.02	.13*					
7. Child-staff ratio (T1)	-.01	-.03	-.06	-.02	.06	-.12**				
8. ECERS-R Interaction score (T1)	.05	-.02	.11*	.02	.01	-.04	.07			
9. Persistence (T2)	.34***	.32***	.46***	.35***	.13*	.03	.07	.17*		
10. Mathematics achievement (T3)	.19**	.30***	.42***	.28***	.17**	.04	.04	.14*	.48***	
11. Reading achievement (T3)	.27***	.24***	.28***	.28***	.15*	.06	.04	.09	.47***	.45***

Note. ECERS-R = Early Childhood Environment Rating Scale-Revised Edition (Interaction Factor). * $p < .05$. ** $p < .01$. *** $p < .001$

Results

Descriptive Statistics

Descriptive statistics for primary study variables are shown in Table 1. Zero-order correlations among primary study variables are displayed in Table 2. Overall, correlation sizes were low to moderate. Correlations were highest among preschool mathematical skills and phonological working memory ($r = .52$), Grade 1 persistence ($r = .46$), and Grade 2 mathematics achievement ($r = .42$) as well as among preschool self-regulation and Grade 1 persistence ($r = .37$). Correlations between

persistence and Grade 2 achievement were moderate (reading: $r = .47$, mathematics: $r = .48$). As might be expected, correlations between home environment variables (SES, parent-child interactions) and Grade 2 achievement (range: .15-.28) were larger than those between preschool quality variables and Grade 2 achievement (range: .04-.14).

Indirect Effects of Preschool Quality via Persistence

Table 3 displays standardized coefficient estimates from path models predicting second grade achievement from preschool quality and first-grade

Table 3
Standardized Coefficients of the Associations Between Preschool Predictors, Grade 1 Persistence, and Grade 2 Achievement

	Model 1				Model 2			
	Persistence		Mathematics		Persistence		Reading	
	β	SE	β	SE	β	SE	β	SE
Self-regulation	.243***	.049	.026	.073	.234***	.050	.002	.064
Phonological working memory	.083	.057	.077	.057	.083	.059	.083	.069
Mathematical skills	.297***	.057	.262***	.063	.306***	.058	.050	.067
SES	.165*	.074	.108	.069	.165*	.074	.126**	.048
Parent-child interaction	-.006	.064	.063	.052	-.006	.064	.047	.060
Home learning environment	-.033	.065	-.031	.053	-.036	.064	.035	.049
Child-staff ratio	.039	.044	.021	.057	.044	.045	-.002	.047
ECERS-R Interaction Factor	.147*	.058	.052	.054	.146*	.058	.039	.051
ECERS-R \times SES	-.153*	.075	-.005	.050	-.147*	.072	-.032	.048
Persistence			.274***	.073			.301**	.097
Covariates		Inc.		Inc.		Inc.		Inc.
R ²		.38***		.32***		.38***		.23***

Note. Preschool quality and SES are grand mean centered. ECERS-R = Early Childhood Environment Rating Scale-Revised Edition (Interaction Factor); SES = socioeconomic status (International Socio-Economic Index of occupational status). * $p < .05$. ** $p < .01$. *** $p < .001$.

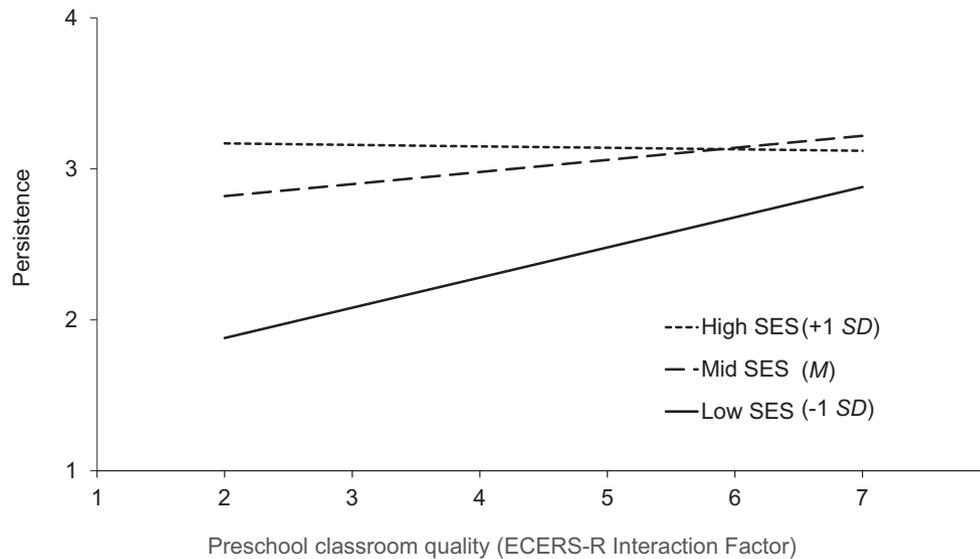


Figure 2. Moderating effects of parental SES on the association between teacher–child interaction quality and first-grade persistence. ECERS–R = Early Childhood Environment Rating Scale–Revised Edition; SES = socioeconomic status.

persistence. Children’s self-regulatory abilities to manage emotions and to focus their attention as well as their mathematical skills in preschool predicted persistence in first grade in both models (Model 1: $\beta_{\text{self-reg}} = .24$, $SE = .049$, $p < .001$; $\beta_{\text{math}} = .30$, $SE = .057$, $p < .001$; Model 2: $\beta_{\text{self-reg}} = .23$, $SE = .050$, $p < .001$; $\beta_{\text{math}} = .31$, $SE = .058$, $p < .001$). Persistence significantly predicted both mathematics ($\beta = .27$, $SE = .073$, $p < .001$) and reading achievement ($\beta = .30$, $SE = .097$, $p = .002$) in second grade. There were no direct effects of preschool quality as measured by the ECERS–R Interaction score on either outcome variable but significant indirect effects of preschool quality via persistence on mathematics achievement ($\beta = .04$, 95% CI [0.008, 0.073], $SE = .017$, $p = .015$) and reading achievement ($\beta = .04$, 95% CI [0.002, 0.086], $SE = .022$, $p = .041$). Thus, children’s persistence in first grade was associated with the quality of their preschool experiences and mediated the link between preschool quality and academic achievement in second grade.

Moderation of Indirect Effects by SES

Parental SES moderated the relation between preschool quality and persistence (a -path) in both Model 1 ($\beta = -.15$, $SE = .075$, $p = .042$) and Model 2 ($\beta = -.15$, $SE = .072$, $p = .042$), but not the direct effect of preschool quality on second-grade achievement (c' -path). Figure 2 displays the relation between quality of teacher–child interactions and persistence depending on parental SES. In addition,

analyses including interaction terms for Self-Regulation \times ECERS–R and Gender \times ECERS–R were conducted for both outcome measures. None of these interaction terms were found to be significant indicating that the effect of teacher–child interactions on persistence did not vary depending on children’s self-regulation skills or gender.

Given the significant interaction SES \times ECERS–R, the indirect effect of preschool quality on achievement via the mediator was tested for children with low (-1 SD), middle (M), and high ($+1$ SD) parental SES. Table 4 presents the unstandardized coefficients with confidence intervals estimating specific indirect effects of preschool quality on Grade 2 achievement via persistence for children with low, middle, and high family SES. Results indicated significant indirect effects on both outcomes for children with low parental SES (Model 1: $B = .23$, 95% CI [0.05, 0.42], $SE = .096$, $p = .015$; Model 2: $B = .84$, 95% CI [0.08, 1.61], $SE = .390$, $p = .017$) and middle parental SES (Model 1: $B = .12$, 95% CI [0.02, 0.21], $SE = .048$, $p = .031$; Model 2: $B = .42$, 95% CI [0.02, 0.82], $SE = .205$, $p = .042$), but not for children with high SES background.

To check the robustness of these results, analyses were also conducted using a bootstrapping procedure ($n = 5,000$) to estimate standard errors and to obtain confidence intervals. The bootstrapped results yielded the same coefficient estimates and very similar standard errors for indirect effects (see Table S2). In sum, positive effects of preschool

Table 4

Estimates With Confidence Intervals for Specific Indirect Effects of Preschool Quality on Grade 2 Achievement via Persistence for Children With Low, Middle, and High Parental SES

	Mathematics				Reading			
	Specific indirect effect		95% CI		Specific indirect effect		95% CI	
	Est.	SE	Lower	Upper	Est.	SE	Lower	Upper
ECERS-R → PE								
Low-SES (−1 SD)	.234*	.096	0.046	0.422	.842*	.390	0.077	1.607
Middle-SES (M)	.115*	.048	0.021	0.210	.417*	.205	0.015	0.819
High-SES (+1 SD)	−.003	.067	−0.136	0.129	−.007	.242	−0.481	0.466

Note. Scores for ECERS-R, persistence and SES are grand-mean centered. ECERS-R = Early Childhood Environment Rating Scale-Revised Edition (Interaction Factor); PE = persistence (Grade 1); SES = socioeconomic status; Est. = unstandardized coefficients.

* $p < .05$.

quality on persistence and, indirectly, on later academic achievement were more likely to emerge for children from socioeconomically disadvantaged backgrounds.

Discussion

This study set out to investigate whether children's preschool experiences embodied in teacher-child interactions contribute to their persistence in academic tasks at transition into formal schooling. More precisely, this investigation aimed to answer two research questions: First, does persistence in academic tasks provide a mediating link between the early history of teacher-child interactions and later achievement? Second, are these associations stronger for children from disadvantaged backgrounds?

In sum, the evidence from this study suggests that the effects of teacher-child interactions in preschool on children's persistence in first grade provide a possible link for the relation between preschool quality and children's later academic achievement. Another notable result to emerge from the data is that positive effects of teacher-child interactions on children's persistence and, indirectly, on their later achievement were stronger for low-SES children. This finding is noteworthy because so far it has not been established whether effects of early teacher-child interactions on children's ability to persist in learning situations vary by parental SES. Taken together, these findings highlight the role of preschool classroom environments in shaping the school readiness of children with socioeconomic risk factors. In the following, the two main findings are discussed in turn.

Indirect Effects of Preschool Quality on Later Achievement

First, results indicate that persistence plays a mediating role between preschool classroom quality and reading and math achievement in the early elementary years. This finding adds to a growing body of literature demonstrating that higher classroom quality is associated with more positive learning behavior in 4- to 6-year-olds (Domínguez et al., 2010; Rimm-Kaufman et al., 2009). Furthermore, it seems to be supported by research demonstrating positive associations between classroom quality and better EF skills (Hamre et al., 2014; Weiland et al., 2013). Nevertheless, although similarly relevant for achievement outcomes, EFs should be conceptually distinguished from persistence. On the one hand, EFs affect children's behavior across a variety of contexts, whereas persistence is directly relevant to children's engagement in academic routines and classroom adaptation (Duncan & Magnuson, 2011; Razza et al., 2015). On the other hand, there is ample evidence to suggest that learning behaviors partly mediate the effects of EF skills on achievement outcomes showing that they have an independent role in shaping achievement trajectories (Nesbitt et al., 2015; Sasser et al., 2015; Sung & Wickrama, 2018). The fact that children's persistence served as a mediator between teacher-child interactions and later achievement indicates that, in the present sample, children who attended high-quality classrooms in preschool were more likely to profit from the promotion of skills that allowed them to better engage in learning activities with sustained effort. This finding adds a novel aspect to the large body of research on preschool quality

effects by showing that positive experiences in the preschool classroom shape children's achievement trajectories beyond direct effects on their academic skills. Adapting positively to demanding academic tasks during transition into formal schooling is a central aspect of school adjustment. High-quality interactions with preschool teachers might play a special role in helping children to be prepared for this task with indirect effects on later school achievement. In sum, the current findings suggests that the effects of teacher-child interactions in preschool on children's persistence in first grade provide a possible link between preschool quality and children's later academic achievement.

The results of this study showed further that persistence also mediated the effect of early mathematical skills on later achievement. One possible interpretation of this finding is that measures of persistence partly tap motivational aspects (Fantuzzo et al., 2004). In longitudinal cross-lagged analyses, better math skills at school entry have been shown to promote greater academic motivation in 5- to 6-year olds (Viljaranta, Lerkkanen, Poikkeus, Aunola, & Nurmi, 2009). Thus, increased effort and perseverance in completing learning tasks might partly reflect academic motivation induced by children's experience of success in meeting academic demands (Stipek et al., 2010). However, this interpretation remains highly speculative as the current measure of persistence does not allow to disentangle children's behavior from their motivational dispositions. Further research that, in addition to teacher reports, also draws on self-report measures of children's academic orientations (Ruzek et al., 2019) holds the promise to more directly determine the relation between children's motivational dispositions, preschool classroom quality, and later achievement.

Strengths of Indirect Effects of Preschool Quality Vary by SES

The second main finding from this investigation revealed that children from low-SES backgrounds who attended high-quality classrooms in preschool showed stronger quality effects on their persistence at age 7 and, indirectly, on their second-grade math and reading achievement. In accordance with previous studies, individual differences in the ways in which children approach and stay engaged in learning situations were associated with parental SES (McClelland et al., 2000; Morgan et al., 2009; Sung & Wickrama, 2018). Children from lower SES backgrounds showed poorer persistence in academic

tasks as rated by their elementary school teachers in first grade. SES moderated the relation between preschool classroom quality and persistence indicating stronger effects for children from disadvantaged family backgrounds. This lends support to some previous findings in the literature reporting differential effects of preschool quality (Dearing et al., 2009; Peisner-Feinberg et al., 2001). While prior work on differential quality effects has tended to focus on academic skills (language, literacy, and math) and problem behaviors, this study complements this research and extends our knowledge by highlighting positive effects of preschool quality on school readiness outcomes that, so far, have received less attention.

At the same time, the current findings also implicate that for children with SES-risk factors the achievement gap is widening when attending low-quality preschool programs. Nevertheless, results indicating compensatory effects of preschool quality based on a single data set should be interpreted with caution given that recent meta-analytic research revealed very limited evidence to support moderation effects of the relation between preschool quality and school readiness outcomes more generally (Keys et al., 2013). In addition, interpreting findings on differential effects of preschool quality is complicated by the fact of socioeconomic gaps in preschool participation. Children from socioeconomically disadvantaged families are enrolled less often in ECE programs and are less likely to receive access to high-quality teacher-child interactions (Bassok & Galdo, 2016). Similarly, research from the German context based on nationally representative data found socioeconomic and ethnic disparities in ECE participation for children under the age of 3 (Jessen, Schmitz, Spieß, & Waights, 2018). For children aged 3 and older (the age group investigated in this study), ECE participation and access to high quality in the German preschool system is less dependent on SES, but children with minority language background tend to be disadvantaged in receiving high-quality ECE experiences (Jessen et al., 2018). In other words, neighborhoods with greater proportions of minorities have preschool classrooms with lower levels of process quality and this may limit the practical implications of compensatory effects as observed in this study.

One unexpected finding was that although persistence was associated with socioeconomic measures of family background (ISEI), it was not associated with measures of parenting characteristics. One possible explanation might be that the

parenting measures in this study were more strongly related to the stimulation of preacademic skills (literacy and math) and less suited to pick up aspects of parenting behavior promoting self-regulatory skills and persistence. In addition, it may well be the case that the assessment of parental cognitive stimulation at age 3.5 was more relevant to earlier developmental outcomes whereas the measure of SES represents a more stable predictor over time. There is yet a very limited amount of empirical work on the relation between parenting characteristics and persistence and previous studies have produced mixed results. In an analyses of data from the NICHD study, Drake, Belsky, and Fearon (2014) found that positive early parenting (secure attachment) at 15 and 36 months of age was related to growth in children's self-control, but not to task persistence in the early elementary years. Morgan et al. (2009) found low-quality parenting (as measured by the HOME inventory) to be a risk factor for a child's inability to self-regulate learning-related behaviors at 24 months of age. Further work needs to establish which parenting characteristics (including parenting beliefs) impact children's development of persistence.

Limitations

The findings obtained should also be considered against some limitations concerning the interpretation of these results. The first issue relates to the constrained measurement of behavioral self-regulation. Self-regulation was assessed through preschool teacher ratings and did not include other potentially important variables such as direct measures of EF skills like inhibitory control. Although, in general, it is assumed that persistence in learning situations is conceptually distinct from EF (Razza et al., 2015; Sasser et al., 2015; Sung & Wickrama, 2018), potentially, inhibitory control might be underlying both teacher-rated self-regulation as well as persistence and, therefore, the pattern of results in the present analyses. Unfortunately, EF measures were not available in the BiKS data. Including assessments of inhibitory control (and other EF skills) is an important task for future research in order to determine whether the relation between early self-regulation and later persistence in academic tasks share a potential common underlying source not controlled for in this study.

An additional limitation of the data is the fact that analyses relied on a single time point of measurement for persistence. Although the available data allowed to examine individual differences in

these skills and how they relate to children's prior preschool experiences, they did not allow to investigate the change in persistence across the transitional period from nonformal schooling to formal schooling. There is some evidence for longitudinal variation in persistence, particularly among children who succeed academically in elementary grades and those who do not (McDermott et al., 2014). Future research will have to address more closely whether individual growth trajectories resemble similar patterns of association with both learning environment variables as well as individual background characteristics as reported in this study. Furthermore, one needs to bear in mind that teacher expectations are likely to be involved in ratings of persistence and these expectations and judgments might be affected by children's sociodemographic characteristics (Rimm-Kaufman, Pianta, & Cox, 2000).

Finally, given that the findings are based on a limited number of dimensions of teacher-child interactions of the ECERS-R, the results from the current analyses should be treated with caution. Although this study provides evidence that the quality of interactions between children and their preschool teachers is associated with persistence at transition into formal schooling, the present data does not allow to identify precisely the effective features and dimensions of these interactions. There is some evidence that clear and consistent expectations for behavior, routines, and learning objectives are some of these features (Hamre et al., 2014; Rimm-Kaufman et al., 2009). Other factors might include teachers' appraisal of children's efforts. Such behavioral features potentially help children to internalize that effort and persistence are positive behaviors. On the other hand, children with lower levels of persistence are less likely to receive positive feedback from their teachers and are less likely to establish positive teacher-child relationships (Portilla, Ballard, Adler, Boyce, & Obradović, 2014). Thus, future research will have to determine more precisely the dynamic reciprocal interplay between children's persistence and the accompanying reinforcing behaviors of teachers.

Conclusions

Persistence and the ability to work independently have long been regarded as quintessential school readiness skills. Early childhood educators frequently emphasize their importance well above the importance of preacademic skills when asked which abilities they find most relevant for children

to be ready for formal schooling (Bassok, Latham, & Rorem, 2016). There is some consensus among researchers and educational bodies that the ways in which children approach and stay engaged in learning situations in conjunction with early academic skills are key factors in determining long-term school success. The findings from this study lend support to the possibility that children's ability to persist in learning situations might be targeted directly by early intervention efforts. Enhancing the development of skills that allow children to persevere in difficult tasks is crucial as they represent key behavioral features that are relevant to success in school, higher education, and the workplace in adulthood. The results of this study indicate that children coming from low-income families may be particularly likely to profit from such interventions. Similarly, the current findings speak to the debate on differential effects of preschool education programs. They emphasize that beyond cognitive skills more attention should be given to the ways in which preschool learning environments foster behaviors and attitudes that prepare children from less affluent backgrounds for future learning.

References

- Alexander, K. L., Entwisle, D. R., & Dauber, S. L. (1993). First-grade classroom behavior: Its short- and long-term consequences for school performance. *Child Development, 64*, 801–814. <https://doi.org/10.1111/j.1467-8624.1993.tb02944.x>
- Anders, Y., Roßbach, H.-G., Weinert, S., Ebert, S., Kuger, S., Lehl, S., & von Maurice, J. (2012). Home and preschool learning environments and their relations to the development of early numeracy skills. *Early Childhood Research Quarterly, 27*, 231–244. <https://doi.org/10.1016/j.ecresq.2011.08.003>
- Bassok, D., Finch, J. E., Lee, R., Reardon, S. F., & Waldfogel, J. (2016). Socioeconomic gaps in early childhood experiences: 1998 to 2010. *AERA Open, 2*, 2332858416653924. <https://doi.org/10.1177/2332858416653924>
- Bassok, D., & Galdo, E. (2016). Inequality in preschool quality? Community-level disparities in access to high-quality learning environments. *Early Education and Development, 27*, 128–144. <https://doi.org/10.1080/10409289.2015.1057463>
- Bassok, D., Latham, S., & Rorem, A. (2016). Is kindergarten the new first grade? *AERA Open, 2*, 233285841561635. <https://doi.org/10.1177/2332858415616358>
- Blair, C., & Raver, C. (2015). School readiness and self-regulation: A developmental psychobiological approach. *Annual Review of Psychology, 66*, 711–731. <https://doi.org/10.1146/annurev-psych-010814-015221>
- Block, J. H., & Block, J. (1980). The role of ego-control and ego-resiliency in the organization of behavior. In W. A. Collins (Ed.), *Minnesota symposium on child psychology* (Vol. 13, pp. 39–101). Hillsdale, NJ: Erlbaum.
- Burchinal, M., Vandergrift, N., Pianta, R., & Mashburn, A. (2010). Threshold analysis of association between child care quality and child outcomes for low-income children in prekindergarten programs. *Early Childhood Research Quarterly, 25*, 166–176. <https://doi.org/10.1016/j.ecresq.2009.10.004>
- Burchinal, M., Zaslow, M., & Tarullo, L. (Eds.). (2016). Quality thresholds, features, and dosage in early care and education: Secondary data analyses of child outcomes. *Monographs of the Society for Research in Child Development, 81*, <https://doi.org/10.1111/mono.12248>
- Caldwell, B. M., & Bradley, R. H. (2003). *Home observation for measurement of the environment: Administration manual*. Little Rock, AR: University of Arkansas.
- Dearing, E., McCartney, K., & Taylor, B. (2009). Does higher quality early child care promote low-income children's math and reading achievement in middle childhood? *Child Development, 80*, 1329–1349. <https://doi.org/10.1111/j.1467-8624.2009.01336.x>
- Domínguez, X., Vitiello, V. E., Maier, M. F., & Greenfield, D. B. (2010). A longitudinal examination of young children's learning behavior: Child-level and classroom-level predictors of change throughout the preschool year. *School Psychology Review, 39*, 29–47. <https://doi.org/10.1080/02796015.2010.12087788>
- Drake, K., Belsky, J., & Fearon, R. M. (2014). From early attachment to engagement with learning in school: The role of self-regulation and persistence. *Developmental Psychology, 50*, 1350–1361. <https://doi.org/10.1037/a0032779>
- Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., . . . Sexton, H. (2007). School readiness and later achievement. *Developmental Psychology, 43*, 1428–1446. <https://doi.org/10.1037/0012-1649.43.6.1428>
- Duncan, G. J., & Magnuson, K. (2011). The nature and impact of early achievement skills, attention skills, and behavior problems. In G. Duncan & R. Murnane (Eds.), *Wither opportunity?* (pp. 47–70). New York, NY: Sage.
- Duncan, G. J., & Magnuson, K. (2013). Investing in preschool programs. *Journal of Economic Perspectives, 27*, 109–32. <https://doi.org/10.1257/jep.27.2.109>
- Duncan, G. J., & Raudenbush, S. W. (1999). Assessing the effects of context in studies of child and youth development. *Educational Psychologist, 34*, 29–41.
- Eisenberg, N., Duckworth, A. L., Spinrad, T. L., & Valiente, C. (2014). Conscientiousness: Origins in childhood? *Developmental Psychology, 50*, 1331–1349. <https://doi.org/10.1037/a0030977>
- Enders, C. K. (2010). *Applied missing data analysis*. New York, NY: Guilford.
- Fantuzzo, J., Perry, M. A., & McDermott, P. (2004). Preschool approaches to learning and their relationship to other relevant classroom competencies for low-income children. *School Psychology Quarterly, 19*, 212–230. <https://doi.org/10.1521/scpq.19.3.212.40276>
- Fuhs, M. W., Farran, D. C., & Nesbitt, K. T. (2013). Preschool classroom processes as predictors of children's

- cognitive self-regulation skills development. *School Psychology Quarterly*, 28, 347–359. <https://doi.org/10.1037/spq0000031>
- Ganzeboom, H. B., & Treiman, D. J. (1996). Internationally comparable measures of occupational status for the 1988 International Standard Classification of Occupations. *Social Science Research*, 25, 201–239. <https://doi.org/10.1006/ssre.1996.0010>
- Gathercole, S., Willis, C., Baddeley, A., & Emslie, H. (1994). The children's test of nonword repetition: A test of phonological working memory. *Memory*, 2, 103–127. <https://doi.org/10.1080/09658219408258940>
- Göttert, R., & Asendorpf, J. (1989). Eine deutsche Version des California-Child-Q-Sort (Block & Block, 1980). Kurzform. [A German version of the California-Child-Q-Sort (Block & Block, 1980). Short form]. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*, 21, 70–82.
- Grimm, H. (2001). *Sprachentwicklungstest für drei- bis fünfjährige Kinder (SETK 3–5)*. [Test of language development for three- to five-year-old children]. Göttingen, Germany: Hogrefe.
- Hamre, B., Hatfield, B., Pianta, R., & Jamil, F. (2014). Evidence for general and domain-specific elements of teacher-child interactions: Associations with preschool children's development. *Child Development*, 85, 1257–1274. <https://doi.org/10.1111/cdev.12184>
- Harms, T., Clifford, R. M., & Cryer, D. (1998). *Early Childhood Environment Rating Scale* (Rev. ed.). New York, NY: Teachers College Press.
- Hatfield, B. E., Burchinal, M. R., Pianta, R. C., & Sideris, J. (2016). Thresholds in the association between quality of teacher-child interactions and preschool children's school readiness skills. *Early Childhood Research Quarterly*, 36, 561–571. <https://doi.org/10.1016/j.ecresq.2015.09.005>
- Howes, C., Burchinal, M., Pianta, R., Bryant, D., Early, D., Clifford, R., & Barbarin, O. (2008). Ready to learn? Children's pre-academic achievement in pre-kindergarten programs. *Early Childhood Research Quarterly*, 23, 27–50. <https://doi.org/10.1016/j.ecresq.2007.05.002>
- Jessen, R., Schmitz, S., Spieß, C. K., & Waights, S. (2018). Child care attendance still depends on the family background. *DIW Weekly Report*, 85, 826–834. https://doi.org/10.18723/diw_wb:2018-38-1
- Keys, T. D., Farkas, G., Burchinal, M. R., Duncan, G. J., Vandell, D. L., Li, W., . . . Howes, C. (2013). Preschool center quality and school readiness: Quality effects and variation by demographic and child characteristics. *Child Development*, 84, 1171–1190. <https://doi.org/10.1111/cdev.12048>
- Kocaj, A., Kuhl, P., Jansen, M., Anand Pant, H., & Stanat, P. (2018). Educational placement and achievement motivation of students with special educational needs. *Contemporary Educational Psychology*, 55, 63–83. <https://doi.org/10.1016/j.cedpsych.2018.09.004>
- Kuger, S., Pflieger, K., & Roßbach, H. G. (2005). *Familieneinschätzungsskala* [Family Assessment Scale]. Bamberg, Germany: University of Bamberg.
- Landerl, K., Wimmer, H., & Moser, E. (1997). *SLRT—Salzburger Lese- und Rechtschreibtest*. [Salzburg Reading and Spelling Test]. Bern, Switzerland: Huber.
- Leyva, D., Weiland, C., Barata, M., Yoshikawa, H., Snow, C., Treviño, E., & Rolla, A. (2015). Teacher-child interactions in Chile and their associations with prekindergarten outcomes. *Child Development*, 86, 781–799. <https://doi.org/10.1111/cdev.12342>
- Li-Grining, C. P., Votruba-Drzal, E., Maldonado-Carreño, C., & Haas, K. (2010). Children's early approaches to learning and academic trajectories through fifth grade. *Developmental Psychology*, 46, 1062–1077. <https://doi.org/10.1037/a0020066>
- Mashburn, A. J., Pianta, R. C., Hamre, B. K., Downer, J. T., Barbarin, O. A., Bryant, D., . . . Howes, C. (2008). Measures of classroom quality in prekindergarten and children's development of academic, language, and social skills. *Child Development*, 79, 732–749. <https://doi.org/10.1111/j.1467-8624.2008.01154.x>
- Mayringer, H., & Wimmer, H. (2003). *Salzburger Lese-Screening für die Klassenstufen 1–4 (SLS 1–4)*. [Salzburg Reading Screening for Grades 1–4]. Bern, Switzerland: Huber.
- McClelland, M. M., Acock, A. C., & Morrison, F. J. (2006). The impact of kindergarten learning-related skills on academic trajectories at the end of elementary school. *Early Childhood Research Quarterly*, 21, 471–490. <https://doi.org/10.1016/j.ecresq.2006.09.003>
- McClelland, M. M., Acock, A. C., Piccinin, A., Rhea, S. A., & Stallings, M. C. (2013). Relations between preschool attention span-persistence and age 25 educational outcomes. *Early Childhood Research Quarterly*, 28, 314–324. <https://doi.org/10.1016/j.ecresq.2012.07.008>
- McClelland, M. M., & Cameron, C. E. (2012). Self-regulation in early childhood: Improving conceptual clarity and developing ecologically valid measures. *Child Development Perspectives*, 6, 136–142. <https://doi.org/10.1111/j.1750-8606.2011.00191.x>
- McClelland, M. M., Morrison, F. J., & Holmes, D. L. (2000). Children at risk for early academic problems: The role of learning-related social skills. *Early Childhood Research Quarterly*, 15, 307–329. [https://doi.org/10.1016/S0885-2006\(00\)00069-7](https://doi.org/10.1016/S0885-2006(00)00069-7)
- McDermott, P. A., Leigh, N. M., & Perry, M. A. (2002). Development and validation of the Preschool Learning Behaviors Scale. *Psychology in the Schools*, 39, 353–365. <https://doi.org/10.1002/pits.10036>
- McDermott, P. A., Rikoon, S. H., & Fantuzzo, J. W. (2014). Tracing children's approaches to learning through Head Start, kindergarten, and first grade: Different pathways to different outcomes. *Journal of Educational Psychology*, 106, 200–213. <https://doi.org/10.1037/a0033547>
- McNeish, D., Stapleton, L. M., & Silverman, R. D. (2017). On the unnecessary ubiquity of hierarchical linear modeling. *Psychological Methods*, 22, 114–140. <https://doi.org/10.1037/met0000078>
- Melchers, P., & Preuss, U. (2003). *Kaufman Assessment Battery for Children (KABC)* (6th ed.). Göttingen, Germany: Hogrefe. (German Version)

- Milfort, R., & Greenfield, D. B. (2002). Teacher and observer ratings of head start children's social skills. *Early Childhood Research Quarterly, 17*, 581–595. [https://doi.org/10.1016/S0885-2006\(02\)00190-4](https://doi.org/10.1016/S0885-2006(02)00190-4)
- Morgan, P. L., Farkas, G., Hillemeier, M. M., & Maczuga, S. (2009). Risk factors for learning-related behavior problems at 24 months of age: Population-based estimates. *Journal of Abnormal Child Psychology, 37*, 401–413. <https://doi.org/10.1007/s10802-008-9279-8>
- Morgan, P. L., Farkas, G., Hillemeier, M. M., Pun, W. H., & Maczuga, S. (2019). Kindergarten children's executive functions predict their second-grade academic achievement and behavior. *Child Development, 90*, 1802–1816. <https://doi.org/10.1111/cdev.13095>
- Muthén, L. K., & Muthén, B. O. (1998–2012). *Mplus user's guide* (7th ed.). Los Angeles, CA: Author.
- Nelson, T. D., Nelson, J. M., James, T. D., Clark, C. A., Kidwell, K. M., & Espy, K. A. (2017). Executive control goes to school: Implications of preschool executive performance for observed elementary classroom learning engagement. *Developmental Psychology, 53*, 836–844. <https://doi.org/10.1037/dev0000296>
- Nesbitt, K. T., Farran, D. C., & Fuhs, M. W. (2015). Executive function skills and academic achievement gains in prekindergarten: Contributions of learning-related behaviors. *Developmental Psychology, 51*, 865–878. <https://doi.org/10.1037/dev0000021>
- NICHD Early Child Care Research Network. (2016). Early child care and children's development prior to school entry: Results from the NICHD study of early child care. *American Educational Research Journal, 39*, 133–164.
- OECD. (2010). *PISA 2009 results: Overcoming social background—Equity in learning opportunities and outcomes* (Vol. II). <https://doi.org/10.1787/9789264091504-en>
- Pagani, L. S., Fitzpatrick, C., Archambault, I., & Janosz, M. (2010). School readiness and later achievement: A French Canadian replication and extension. *Developmental Psychology, 46*, 984–994. <https://doi.org/10.1037/a0018881>
- Peisner-Feinberg, E. S., Burchinal, M. R., Clifford, R. M., Culkin, M. L., Howes, C., Kagan, S. L., & Yazejian, N. (2001). The relation of preschool child-care quality to children's cognitive and social developmental trajectories through second grade. *Child Development, 72*, 1534–1553. <https://doi.org/10.1111/1467-8624.00364>
- Pianta, R. C., La Paro, K. M., & Hamre, B. K. (2008). *Classroom Assessment Scoring System™: Manual K-3*. Baltimore, MD: Paul H Brookes Publishing.
- Ponitz, C. E. C., McClelland, M. M., Jewkes, A. M., Connor, C. M., Farris, C. L., & Morrison, F. J. (2008). Touch your toes! Developing a direct measure of behavioral regulation in early childhood. *Early Childhood Research Quarterly, 23*, 141–158. <https://doi.org/10.1016/j.ecresq.2007.01.004>
- Portilla, X. A., Ballard, P. J., Adler, N. E., Boyce, W. T., & Obradović, J. (2014). An integrative view of school functioning: Transactions between self-regulation, school engagement, and teacher-child relationship quality. *Child Development, 85*, 1915–1931. <https://doi.org/10.1111/cdev.12259>
- Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40*, 879–891. <https://doi.org/10.3758/BRM.40.3.879>
- Preacher, K. J., Rucker, D. D., & Hayes, A. F. (2007). Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioral Research, 42*, 185–227. <https://doi.org/10.1080/00273170701341316>
- Rauer, W., & Schuck, K. D. (2004). *Fragebogen zur Erfassung emotionaler und sozialer Schulerfahrungen von Grundschulkindern erster und zweiter Klassen* [FEES questionnaire for the assessment of emotional and social school experiences of first and second grade students]. Göttingen, Germany: Beltz.
- Razza, R. A., Martin, A., & Brooks-Gunn, J. (2015). Are approaches to learning in kindergarten associated with academic and social competence similarly? *Child & Youth Care Forum, 44*, 757–776. <https://doi.org/10.1007/s10566-015-9307-0>
- Rimm-Kaufman, S. E., Curby, T. W., Grimm, K. J., Nathanson, L., & Brock, L. L. (2009). The contribution of children's self-regulation and classroom quality to children's adaptive behaviors in the kindergarten classroom. *Developmental Psychology, 45*, 958–972. <https://doi.org/10.1037/a0015861>
- Rimm-Kaufman, S. E., Pianta, R. C., & Cox, M. J. (2000). Teachers' judgments of problems in the transition to kindergarten. *Early Childhood Research Quarterly, 15*, 147–166. [https://doi.org/10.1016/S0885-2006\(00\)00049-1](https://doi.org/10.1016/S0885-2006(00)00049-1)
- Rjosk, C., Richter, D., Lüdtke, O., & Eccles, J. S. (2017). Ethnic composition and heterogeneity in the classroom: Their measurement and relationship with student outcomes. *Journal of Educational Psychology, 109*, 1188–1204. <https://doi.org/10.1037/edu0000185>
- Ruzek, E., Jirout, J., Schenke, K., Vitiello, V., Whittaker, J. V., & Pianta, R. (2019). Using self report surveys to measure PreK children's academic orientations: A psychometric evaluation. *Early Childhood Research Quarterly, 50*, 55–66. <https://doi.org/10.1016/j.ecresq.2018.10.012>
- Sasser, T. R., Bierman, K. L., & Heinrichs, B. (2015). Executive functioning and school adjustment: The mediational role of pre-kindergarten learning-related behaviors. *Early Childhood Research Quarterly, 30*, 70–79. <https://doi.org/10.1016/j.ecresq.2014.09.001>
- Schafer, J. L., & Graham, J. W. (2002). Missing data: our view of the state of the art. *Psychological Methods, 7*, 147–177. <https://doi.org/10.1037/1082-989X.7.2.147>
- Schmerse, D., Anders, Y., Flöter, M., Wieduwilt, N., Roßbach, H.-G., & Tietze, W. (2018). Differential effects of home and preschool learning environments on early language development. *British Educational Research Journal, 44*, 338–357. <https://doi.org/10.1002/berj.3332>
- Schneider, T. (2011). The importance of social and migrant backgrounds for school recommendations in

- Germany at the end of primary school. *Zeitschrift für Erziehungswissenschaft*, *14*, 371–396. <https://doi.org/10.1007/s11618-011-0221-4>
- Shields, A., & Cicchetti, D. (1997). Emotion regulation among school-age children: The development and validation of a new criterion Q-sort scale. *Developmental Psychology*, *33*, 906–916. <https://doi.org/10.1037/0012-1649.33.6.906>
- Stipek, D., Newton, S., & Chudgar, A. (2010). Learning-related behaviors and literacy achievement in elementary school-aged children. *Early Childhood Research Quarterly*, *25*, 385–395. <https://doi.org/10.1016/j.ecresq.2009.12.001>
- Sung, J., & Wickrama, K. A. S. (2018). Longitudinal relationship between early academic achievement and executive function: Mediating role of approaches to learning. *Contemporary Educational Psychology*, *54*, 171–183. <https://doi.org/10.1016/j.cedpsych.2018.06.010>
- Sylva, K., Siraj-Blatchford, I., Taggart, B., Sammons, P., Melhuish, E., Elliot, K., & Totsika, V. (2006). Capturing quality in early childhood through environmental rating scales. *Early Childhood Research Quarterly*, *21*, 76–92. <https://doi.org/10.1016/j.ecresq.2006.01.003>
- Tietze, W., Schuster, K.-M., Grenner, K., & Roßbach, H.-G. (2007). *Kindergarten-Skala Revidierte Fassung (KES-R)* [German version of the Early Childhood Environment Rating Scale-Revised Edition]. Weinheim, Germany: Beltz.
- Vandell, D. L., Belsky, J., Burchinal, M., Steinberg, L., Vandergrift, N.; NICHD Early Child Care Research Network. (2010). Do effects of early child care extend to age 15 years? *Child Development*, *81*, 737–756. <https://doi.org/10.1111/j.1467-8624.2010.01431.x>
- Viljaranta, J., Lerkkanen, M.-K., Poikkeus, A.-M., Aunola, K., & Nurmi, J.-E. (2009). Cross-lagged relations between task motivation and performance in arithmetic and literacy in kindergarten. *Learning and Instruction*, *19*, 335–344. <https://doi.org/10.1016/j.learninstruc.2008.06.011>
- Vitiello, V. E., Greenfield, D. B., Munis, P., & George, J. L. (2011). Cognitive flexibility, approaches to learning, and academic school readiness in Head Start preschool children. *Early Education & Development*, *22*, 388–410. <https://doi.org/10.1080/10409289.2011.538366>
- Votruba-Drzal, E., Coley, R. L., & Chase-Lansdale, P. L. (2004). Child care and low-income children's development: Direct and moderated effects. *Child Development*, *75*, 296–312. <https://doi.org/10.1111/j.1467-8624.2004.00670.x>
- Watts, T. W., Duncan, G. J., Siegler, R. S., & Davis-Kean, P. E. (2014). What's past is prologue: Relations between early mathematics knowledge and high school achievement. *Educational Researcher*, *43*, 352–360. <https://doi.org/10.3102/0013189X14553660>
- Weiland, C., Ulvestad, K., Sachs, J., & Yoshikawa, H. (2013). Associations between classroom quality and children's vocabulary and executive function skills in an urban public prekindergarten program. *Early Childhood Research Quarterly*, *28*, 199–209. <https://doi.org/10.1016/j.ecresq.2012.12.002>
- Weinert, S., Roßbach, H.-G., Faust, G., Blossfeld, H.-P., & Artelt, C. (2013). *Bildungsprozesse, Kompetenzentwicklung und Selektionsentscheidungen im Vorschul- und Schulalter (BiKS-3-10). SUF Version 4. [Educational processes, competence development and selection decisions in preschool and school age (BiKS-3-10)]*. Institute for Educational Quality Improvement (IQB). https://doi.org/10.5159/IQB_BIKS_3_10_v4

Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

Table S1. Drop-Out Comparisons of Children Who Participated in Preschool and in Elementary School With Those Who Dropped Out After Preschool With Independent Samples *t*-Tests and Cohen's *d*

Table S2. Results for Indirect Effects Using Bootstrapping ($n = 5,000$)

Table S3. Results for Moderated Mediation Models